

# Perform Achieve and Trade (PAT) a Revolutionary Measure in Energy Efficiency and Conservation - Review

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**ABSTRACT:** Perform Achieve and Trade (PAT) is a market based policy has the aim to make the industrial sector energy efficient. India's bureau of energy efficiency (BEE) launched this scheme on 4th July, 2012. The proposed PAT scheme has definite set energy efficiency targets for industries. Those fail to achieve targets will have to pay penalty. PAT has been launched under the national mission for enhanced energy efficiency (NMEEE). This is one of the eight missions under the umbrella national action plan on climate change launched in June 2008. PAT is a regulatory mechanism used to educate and enhance energy efficiency by reducing specific energy consumption in large industries with an associated market based scheme to enhance the cost effectiveness through trading of certificates received for the saving of excess energy. This scheme tries to reduce the specific energy consumption of the designated consumers (DCs) for a three years cycle. The target setting and reduction for each DCs is based on their present levels of energy efficiency and the energy efficient DCs will have lower target of percentage reduction, as compared to lesser energy efficient DCs which will have higher targets.

**KEYWORDS:** PAT, Perform achieve and Trade, Energy conservation, Energy Efficiency

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## 1. INTRODUCTION

BEE under Ministry of Power has implemented PAT scheme, a component under NMEEE in India. PAT is a mechanism to enhance cost effectiveness through certification of excess energy savings in energy intensive industries that can be traded. PAT is an innovative policy strictly mandate, market based mechanism launched in 2012. The scheme covers 478 designated consumers from 8 energy intensive sectors. The scheme includes goal setting for the specific energy consumption reduction target for 478 designated consumers. In the Target achieve/reduction phases the designated consumers under take measures to reduce their specific energy consumption by developing action plans. During Trading phase consumers who exceed their target will be credited with tradable energy permits. This scheme encourages to accelerate energy savings in energy intensive and large industries by giving incentives for energy saving. Achievement above the set targets will result in tradable energy saving certificates (ESCerts), whereas under-achievers have to comply by purchase of ESCerts or by paying a penalty. This scheme is expected to result a saving of 6 to 7 million TOE (Tonnes of Oil Equivalent) of energy, and the other benefits would be a reduction of 25 million Tonnes of CO<sub>2</sub> equivalent. Considering the cost of 1 TOE to be Rs. 10,154 as notified by BEE in 2011-12, the cost of energy saved amounts to rupees 6782 crores. In PAT the main focus is to place forward our greatest ideas and values of energy conservation and moderation. This is often additionally necessary within the context that, typical sources square measure running out of

offer and sooner is going to be exhausted. The present study was aimed to understand and study analysis of the PAT Scheme which has been rolled out for eight selected sectors during March 2012. The scope of the study includes an assessment of performance of the scheme in the present cycle and learning's. From the constructive feedback, observations and recommendations the scheme may be further strengthened in the future cycles. To analyze the assorted aspects related to the PAT cycle it is vital to satisfy those that have gained expertise during this field. However each and every trade is attempting to realize their specified targets. The studies have been carried out in consultation with SSEF, BEE and other stakeholders. The overall view is likely, institutional mechanism design as well as role assignments are robust and capable of inspiring confidence among the stakeholders by comprehensive coverage and treatment. The need of the hour is to disseminate the provisions made and develop elaborate working guidelines on roles, independence, practices and procedures etc to supplement the existing system of framework. PAT brings the sure benefits of reduction in CO<sub>2</sub> emission and creates more business and job opportunities in market.

## 2. CURRENT ENERGY SCENARIOS

The country's current energy generation and consumption is greatly alarming. The impact of energy generation on environment is rapidly increasing hence clear and bright policies are highly needed to control and govern else disasters are sure for the same. Fig 1 shows the ever increasing demand and widening short

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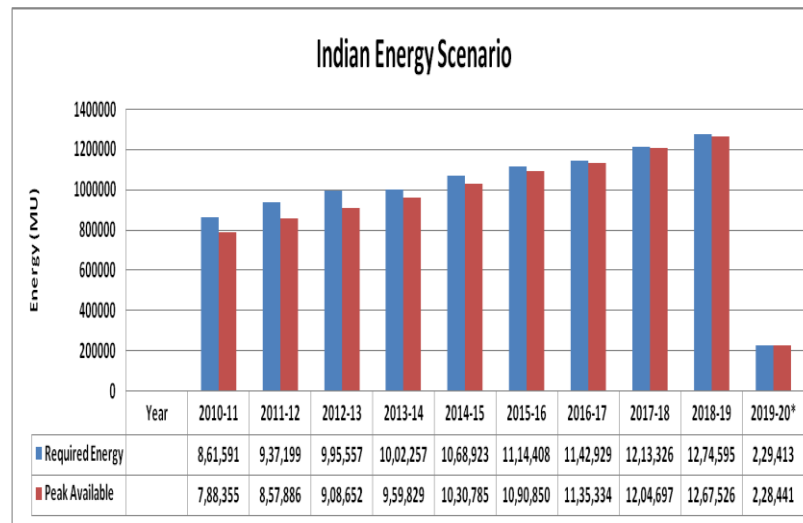
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fall to supply leading to further generation call. Therefore regulatory mechanisms like energy efficiency (Star) ratings and PAT by BEE are supportive

in this respect. Table 1 also depict similar. Fig 2 presents sector wise consumption [1,2].



**Fig 1 Graphical representation of Energy scenario of India**  
(Reference: Central Electricity Authority (CEA), \* Upto May 2019)

India		
SECTORS	MILLION TONNES OF OIL EQUIVALENT (MTOE)	PERCENTAGE OF TOTAL NATIONAL CONSUMPTION
Electricity Generation	179.29	25.3%
Industry	179.09	25.3%
Transport	74.79	10.6%
Residential	182.88	25.8%
Commercial & Public Service	20.55	2.9%
Agriculture	23.75	3.4%
Non Energy Use	47.26	6.7%
Total	707.61	

**Fig 2 Total energy consumption sector wise view**  
(Reference: Central Electricity Authority (CEA), \* Upto May 2019)

Table 1 Indian Energy scenario				
Year	Requirement	Availability	Surplus(+)/Deficits(-)	
	(MU)	(MU)	(MU)	(%)
2009-10	8,30,594	7,46,644	-83,950	-10.1
2010-11	8,61,591	7,88,355	-73,236	-8.5
2011-12	9,37,199	8,57,886	-79,313	-8.5
2012-13	9,95,557	9,08,652	-86,905	-8.7
2013-14	10,02,257	9,59,829	-42,428	-4.2
2014-15	10,68,923	10,30,785	-38,138	-3.6
2015-16	11,14,408	10,90,850	-23,558	-2.1
2016-17	11,42,929	11,35,334	-7,595	-0.7
2017-18	12,12,134	12,03,567	-8,567	-0.7
2018-19*	1,04,297	1,03,761	-536	-0.5

(Reference: Central Electricity Authority (CEA), \* Upto May 2019)

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### 3. PERFORM, ACHIEVE AND TRADE (PAT)

PAT scheme is designed to enhance the effectiveness and energy efficiency in energy intensive and large industries and facilities, through certification of energy savings that could be traded. This mechanism brings the large variation in energy intensities of different units in almost in every sector. With respect to Sec 14(g) of the EC act, the Government has notified targets (in the form of SEC) for 478 DCs in the eight industrial sectors during March 2012 under the PAT cycle-I. The reduction in energy intensity and target for each unit is dependent on its present efficiency. The aimed reduction target is less for those efficient systems and is higher for those less efficient units. Fig 3 shows the historical evolution of PAT.

#### 3.1 Salient features of PAT and working

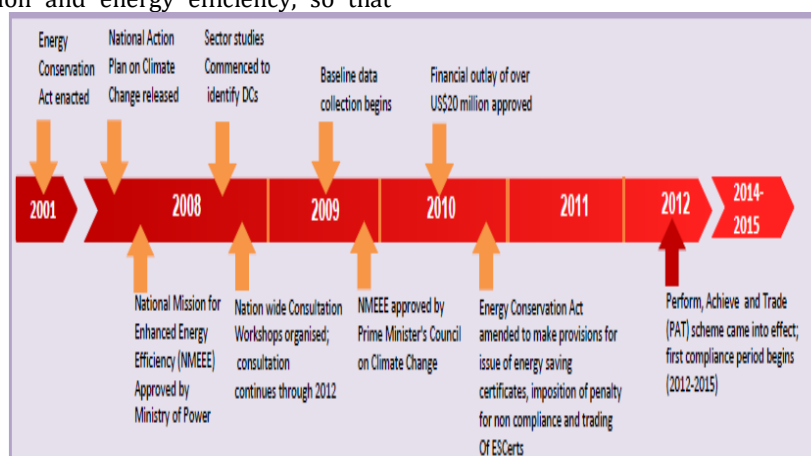
PAT system and its associated mechanisms give an opportunity to reduce specific energy consumption leading to cost effectiveness through certification method and which can be traded. Following are the salient features noted.

- Regulatory measure or an instrument which is linked with market mechanism which helps to obtain certification of energy saving
- Consultative approach - Ministries/DCs/Associations/FIs/Research Organizations
- Outreach/ Capacity Development - Workshops/Seminars/ Visits
- Self – competing - Unit specific targets
- Relative responsibility for setting targets like low target for more efficient and more for less efficient system.
- Work as a supportive tools to improve energy management system by measurement, recording and reporting

The PAT scheme assigns the targets to reduce specific energy consumption and saving targets to the Designated Consumers (DCs) for a three year cycle. The target reduction for each DC is based on their present consumption and energy efficiency, so that

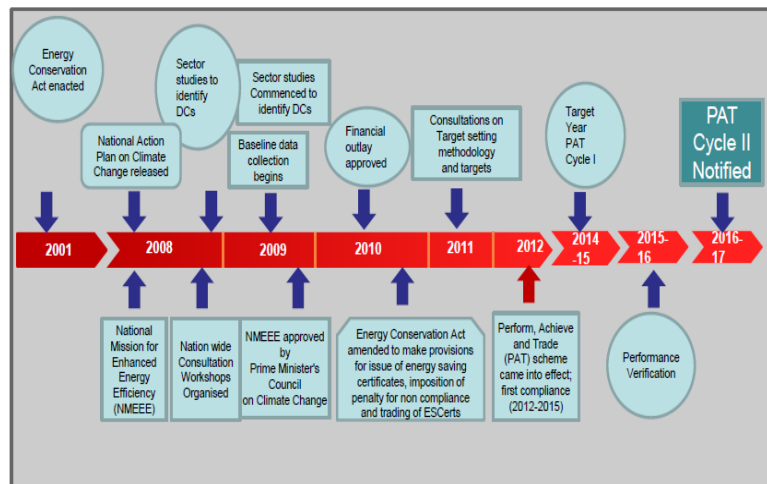
energy efficient DCs will be given with smaller and that slightly inefficient consumer with larger target values. For the calculation of the specific energy consumption against the total production, data is collected by “gate-to-gate” approach. This procedure is followed to work out with relevant energy efficiencies, consumption and verification of the performance of DCs at the end of the cycle by the accredited energy auditors by Bureau of Energy Efficiency [3].

PAT Cycle-I (2012-13 to 2014-15) was envisaged to reduce the SEC of 478 designated consumers (DCs) from eight energy intensive sectors namely ,Thermal power plant, Textile, Iron and steel, Aluminum, Cement, Chlor- Alkali, Fertilizer, Paper and Pulp etc. From the study and analysis the overall energy saving targets for PAT Cycle –I was 6.686 Million Tonne of Oil Equivalent (MTOE) by the end of year 2014-15. The achievement in PAT Cycle-I is 8.67 MTOE which is an over achievement of about 30 percent in comparison to the assigned targets. This energy saving translates in to avoiding about 31 million tons of CO<sub>2</sub> emission. Ministry of Power has already issued energy saving certificates (ESCerts) in lieu of energy saving beyond their targets and entitlement to purchase of ESCerts for compliance to meet their shortfall towards their targets. There are 306 DCs who have been cumulatively issued about 38.50 lakh ESCerts in lieu of their excess energy saving against the targets and there are 110 DCs that are cumulatively entitled to purchase about 14.50 lakh ESCerts to meet their shortfall to meet energy saving targets. The ESCerts could be traded at two energy exchanges that is Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL) or bought by other units under PAT who can use them to meet their compliance requirements. Units that are unable to meet the set targets either by their own actions or through purchase of ESCerts are sure to face financial penalty under the Energy Conservation Act. The trading infrastructure is currently under finalization and trading is started in the month of April/May. Fig 4 shows the phase and working of PAT mechanism and Fig 5 the implementation of PAT as on 2017 [4].



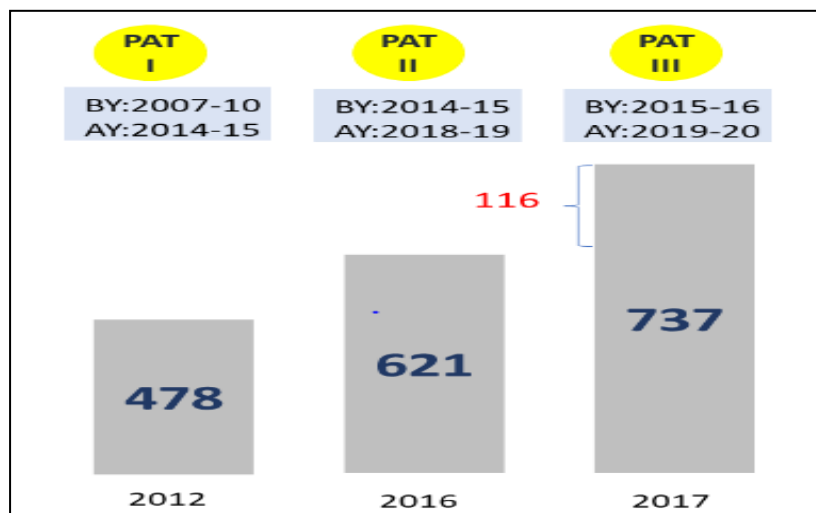
**Fig 3 Historical mile stones in the view of PAT**  
(Reference: Bureau of Energy Efficiency, 2012. PAT Booklet [3])

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**Fig 4 Time diagram of Working of PAT**

(Reference: Market Based Mechanism to Improve Industrial Energy Efficiency [4])



**Fig 5 Industry implementation of PAT by 2017**

(Reference: Energy Reduction targets for Electricity Distribution companies for PAT Cycle II [5])

PAT Cycle –II (2016-17 to 2018-19) was expanded to new sectors and new DCs in PAT Cycle –II namely, Railways, Refineries and Electricity Distribution Companies (DISCOMs). PAT Cycle-II has been notified on 31st March, 2016 and aimed to achieve an overall energy reduction in consumption by 8.869 MTOE. Under PAT Cycle-II, energy reduction targets have been assigned and notified to 621 DCs (out of which 448 are existing, 89 additional DCs from existing sectors and 84 DCs from new sectors mainly in Railways, Electricity DISCOMs and Refineries). Fig 6 shows the information related to old eight sectors and added new ones to the system (eight existing sectors and three new sectors).

PAT Cycle –III (2017-18 to 2019-20) scheme is currently proposed to be implemented on rolling basis (i.e. annual inclusion of new DCs). In this regard, the PAT Cycle III has been notified on 30<sup>th</sup> March, 2017 to be effective from 1st April, 2017 with inclusion of 116 new DCs. The identified 116 DCs found consume about 35 MTOE while they have been assigned energy saving

target of 1.06 MTOE at the end of the cycle-III by 2019-20. In total, there are 737 DCs [4,5].

### 3.2 Challenges for the implementation of PAT

The following challenges were experienced in the implementation of waste heat recovery systems in two industries namely, Iron & Steel and Cement. High capital cost, quality of heat and equipment maintenance etc. The capital cost to implement a waste heat recovery system may outweigh the benefits gained in heat recovered. Therefore, it is necessary to analyze the cost benefit by considering all the facts clearly. The cost implications for only installing waste heat recovery boilers (WHRB) and other accessories is around USD 0.75 million. The cost of installing whole units along with waste heat recovery in large plants is USD 22.23 million as in an Iron & Steel plant. The cost implication in the Cement industry is approximately USD 11.25 million. Often, waste heat is of low quality (temperature). Some time it is challenging and difficult to utilize the whole of the recovered quantity of low quality heat contained in a waste heat medium. Heat

exchangers tend to be larger to recover significant quantities, which increases the capital cost. Additional equipment requires additional maintenance cost [6].

### 3.3 Impact on the generation of Environment

A reduction of 2% in CO<sub>2</sub> emission by 400 industries was observed in 2012-15 [6]. By the implementation of PAT mechanism an energy audit is done to verify the baseline energy consumption of a specific industry to assess the present consumption level and energy efficiency. The individual targets are given to industrial units. The intensive energy consuming industries that consume more energy per unit production are given targets higher than their energy efficient counter parts. This promotes and enhances overall energy savings, as companies strive to surpass their own performance from their past consumption rather than competing with other. According to the statements and achievements of first cycle of PAT (2012 -15) this avoided generation of about 5,635 MW, resulting in monetary savings of Rs 37,685 crore and saving of Rs 9,500 crore have been noticed due to reduction in energy consumption. Therefore PAT is one of the most important initiatives under the NMEEE under National Action Plan on Climate Change (NAPCC) in 2012 [6,7].

### 3.4 Effects of the policy on different areas

PAT II targets energy savings of approximately 18.0 MTOE in the 707 covered facilities under 11 sectors. A comparative assessment of PAT cycle I and PAT cycle II on specific energy consumption (SEC) for power, iron and steel, cement and textile sectors indicate a gradual shift towards the reduction in specific energy consumption in each industry. It is also observed that plants with extremely high SECs are targeted to reduce much faster than plants that have low SECs. The savings in energy have reduced the carbon footprint of the output and also provided cost reductions. For example, energy savings under the PAT scheme in cement manufacturing have resulted in a reduction in CO<sub>2</sub> emissions by 25 kg CO<sub>2</sub>/tone of cement and a 15% reduction in power cost [8].

### 3.5 Benefits of PAT and The targeted savings in Cycle I and Cycle II

Electricity generation and industry account for 50% of total energy consumption in India. Some of

these industries use state of the art technologies and performance management, while some plants are close to being obsolete. Thus, there is a wide range of energy efficiency performance at the plant level. The PAT scheme was initiated with the purpose of bringing the energy efficiency of energy intensive industrial sectors in India to a higher level of performance as measured through their specific energy consumption (SEC). SEC is energy consumed to produce one unit of output by a plant. It was envisaged that a total saving of 4.05%<sup>1</sup> in total energy consumption would happen across the eight sectors. The PAT scheme has been successful in India, and PAT cycle I has already been extended to more industries under PAT cycle II. The PAT scheme is replicable in any country or province, although due diligence is required by the host government to audit historical SEC of targeted designated consumers in that country, and set inappropriate legal framework to implement PAT [9].

Sector wise targets in the PAT scheme require specific interventions, such as raw material management, process improvement, installation of new systems such as waste heat recovery, reducing output wastages through better quality control etc. These vary for industry and at the plant level. For instance, around 40 to 50% of units in the Iron & Steel and Cement sectors across India have gone for waste heat recovery projects. The process, notifications and expertise gained by BEE and empanelled accredited energy auditing firms could, thus, be utilized for the benefit of other countries desirous to replicate the Indian PAT scheme in their own countries. The existing scheme could also be expanded to include GHG emission reductions and carbon and environmental trading markets. Fig 6 presents the targets and achievements by PAT. The second phase of the PAT Scheme (PAT cycle II) runs from 2016-2019, covering 707 units from the 11 energy intensive sectors. PAT cycle II focuses on deepening and widening PAT cycle I - i.e. the inclusion of 61 new DCs from the existing 8 sectors, and the addition of 170 DCs from 3 new sectors, namely, Railways, Refineries and Electricity distribution companies (DISCOM).

S.NO	SECTORS	UNIT OF SEC	PAT CYCLE I		PAT CYCLE II	
			Number of DCs	Targeted Savings (mtoe)	Number of DCs	Targeted Savings (mtoe)
1.	Power (Thermal)	Kcal/kWh	144	3.21	154	3.13
2.	Iron and Steel	toe/tonne of product	67	1.47	71	2.28
3.	Cement	toe/tonne of product	85	0.82	111	1.12
4.	Aluminium	toe/tonne of product	10	0.46	12	0.47
5.	Fertiliser	toe/tonne of product	29	0.48	37	0.45
6.	Paper & Pulp	toe/tonne of product	31	0.12	29	0.15
7.	Textile	toe/tonne of product	90	0.07	99	0.09
8.	Chlor-Alkali	toe/tonne of product	22	0.05	24	0.10
9.	Petroleum Refinery	Million British Thermal Unit per Thousand Barrel per Energy Factor	-	-	20	1.11
10.	Railways	Litres/1000 GTKm	-	-	100	na
11.	DISCOMs	% of Transmission and Distribution losses	-	-	50	0.94
<b>Total</b>			<b>478</b>	<b>6.686</b>	<b>707</b>	<b>18.00</b>

**Fig 6 Targeted savings for PAT**

(Reference: Strengthening energy efficiency mechanism in Indian railways through PAT Scheme [6])





**Fig 7 Impacts of energy generation and usage on environment**

(Reference: Role of electricity distribution companies under PAT cycle II, Bureau of Energy Efficiency [7])

This would expand the coverage from 38% to 70% of total primary energy consumption. There are around 188 units from four sectors (Cement, Pulp & Paper, Iron & Steel, and Textiles), and around 130 units from the remaining four sectors - Aluminium, Fertilisers, Chlor-alkali and Thermal Power Plants. The new sectors - Railway, Refineries and DISCOM include around 170 units to date. More DCs are under identification, which would bring the total to approximately 707 [8-10].

### **3.6 PAT in Achieving Conservation and Efficiency Improving**

The governments energy efficient-LED lamp scheme to improvise energy efficiency and CO<sub>2</sub> emissions as well as effects of best practices and implementations in some of India's most energy-intensive industrial units has purportedly exceeded targets, saving enough energy to avoid or postpone the generation capacity addition which is equal to India's entire nuclear-power capacity as of end 2016, and preventing much CO<sub>2</sub> from being released into the air as would have been discharged by 19.4 million Indians in one year at 2013 levels. Each company was set a target based on the potential for savings. And when they brought about changes, we then verified what they achieved. For those who exceeded expectations, they would be able to trade the surplus in these exchanges with companies who could not achieve the set target in spite of best efforts. The PAT scheme helped save 8.67 million tonnes of oil equivalent (as against target of 6.68 million tonnes), which is about 30% more than the target set. From the literature it is noticed that the reduction in emission by 31 million tonnes of CO<sub>2</sub> and save rupees 9,500 crore due to reduction in energy consumption. These ESCerts provide an opportunity to the industries to en cash the benefits of monetization of energy saving initiatives [11-13].

However, the saving in energy consumption and specific attainments by the industries is not made public by the government and retained as right to keep

them confidential. Releasing or publishing the data even partially by sector, if not by individual unit, for instance would encourage and motivate good performers while creating pressure on under achievers to do better during subsequent cycles. 8.67 million tonnes [14].

### **4. CONCLUSION**

The PAT with its features, additional necessary mechanisms and network is sure to give boost to enhance energy efficiency in technology driven industries. On the successful implementation of PAT scheme, it is possible to achieve breakthrough in research by the industries on energy efficiency and technology process. The exhaustive work carried and presentations strongly propose to use the PAT with different controlling institutions as applicable in the interactive mode with international programs like the Clean Development Mechanism (CDM) and World Bank.

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